



Efficiency Opportunities for Edison-Base Fixtures

Background, Technology and Policy

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Goal

- Save energy
- Reduce demand



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Savings Opportunities

- New construction
- Existing buildings



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New Construction

- Title 24



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Existing Construction

- Edison base sockets incandescent lamps
- Residential
 - Hospitality
 - Commercial



Residential Portables



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Residential Hardwired Fixtures



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Hospitality Portables



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Some Commercial



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Background

- Levine and Huffman
- Title 20
- National efforts
- International



Efficiency Opportunities for Edison-Base Fixtures



How do we get there?

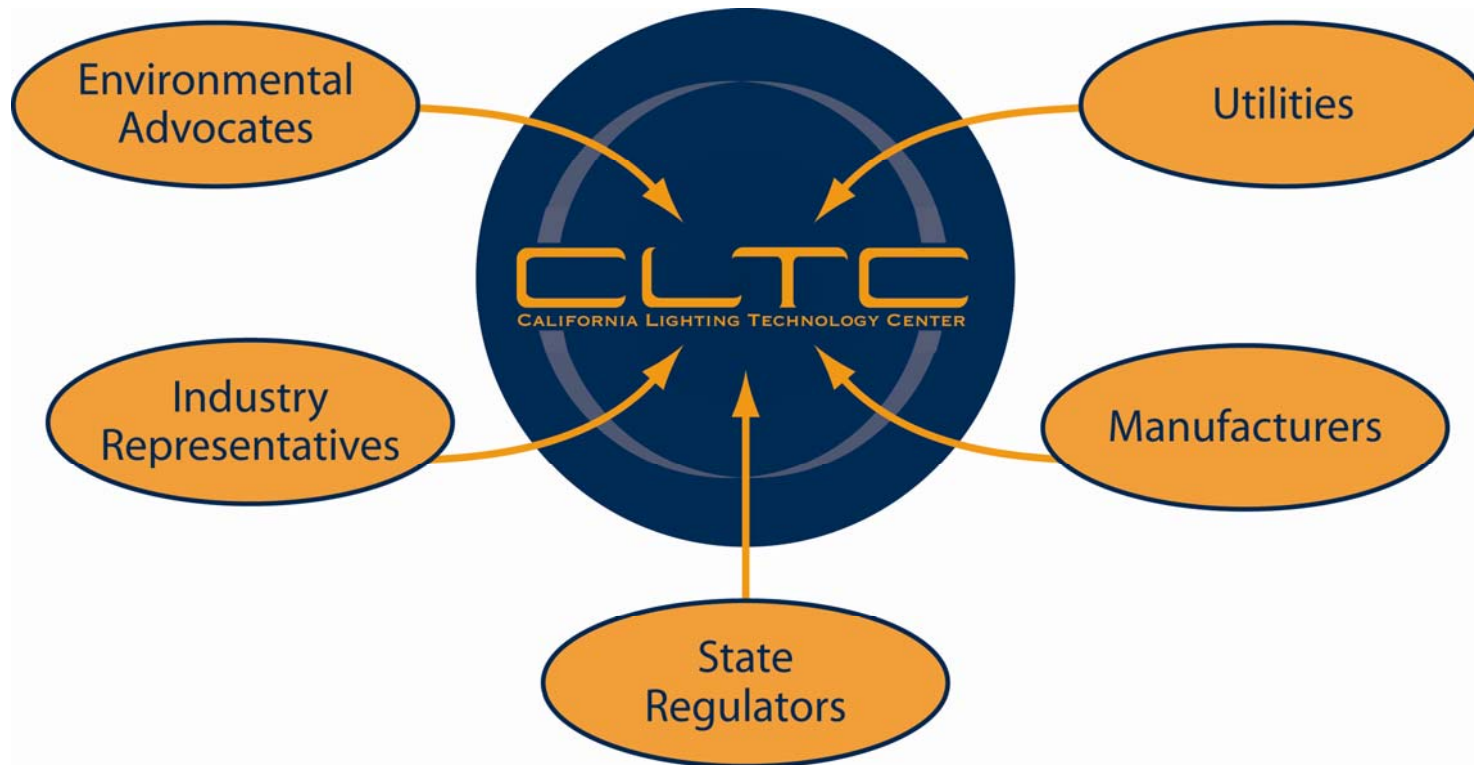
- What's the process?
- What are the variables?

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Our Process - Roundtable



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Presentation Roadmap



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Technologies in Use

Incandescent



Compact fluorescent



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Incandescent: A lamp



- Typical characteristics
 - Wattage: 40-100 W
 - Efficacy: 10-17 lm/W
 - Price: < \$1 (Halogen long-life: \$5)
- Typical applications
 - General lighting

Incandescent: BR Lamp



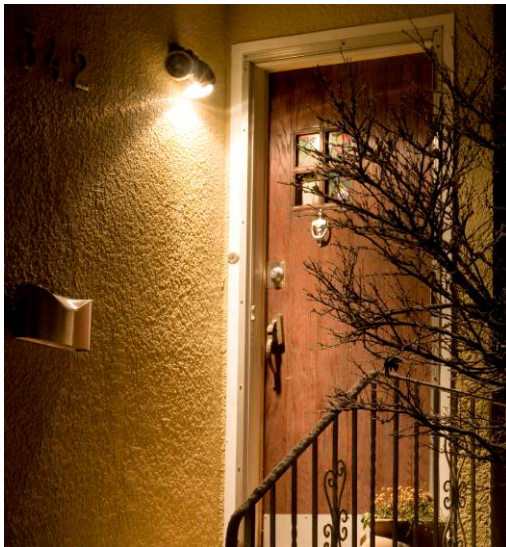
- Typical characteristics
 - Wattage: 30-150 W
 - Efficacy: 7-12 lm/W
 - Price: \$4-7
- Typical applications
 - Downlights
 - Spotlights

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Incandescent: PAR Lamp



- Typical characteristics
 - Wattage: 50-150 W
 - Efficacy: 6-15 lm/W
 - Price: \$6-8
- Typical applications
 - Downlights
 - Spotlights

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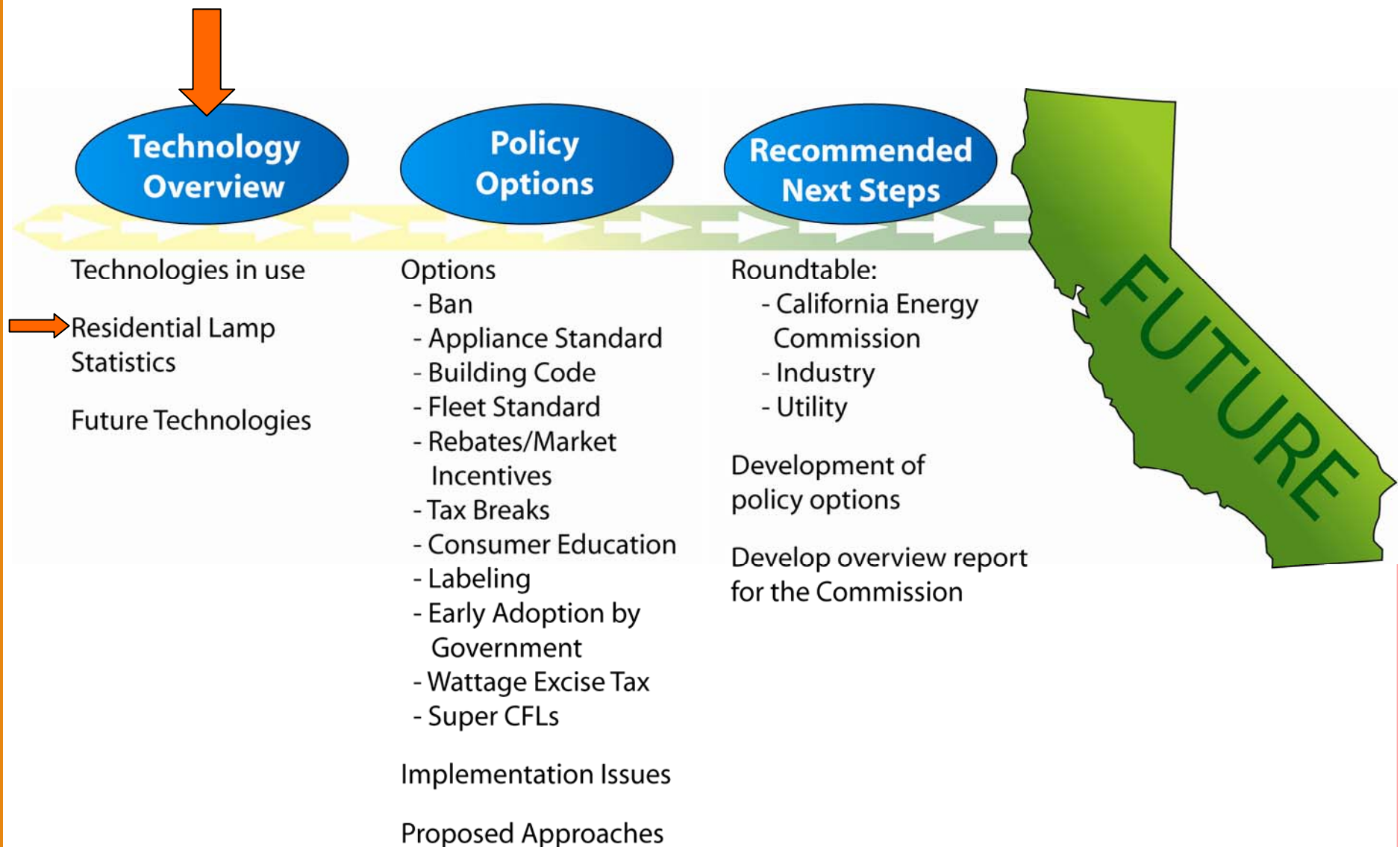
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Fluorescent: CFL



- Typical characteristics
 - Wattage: 5-40 W
 - Efficacy: 50-70 lm/W
 - Price: \$1-8 (non-dimming)
- Typical applications
 - General lighting



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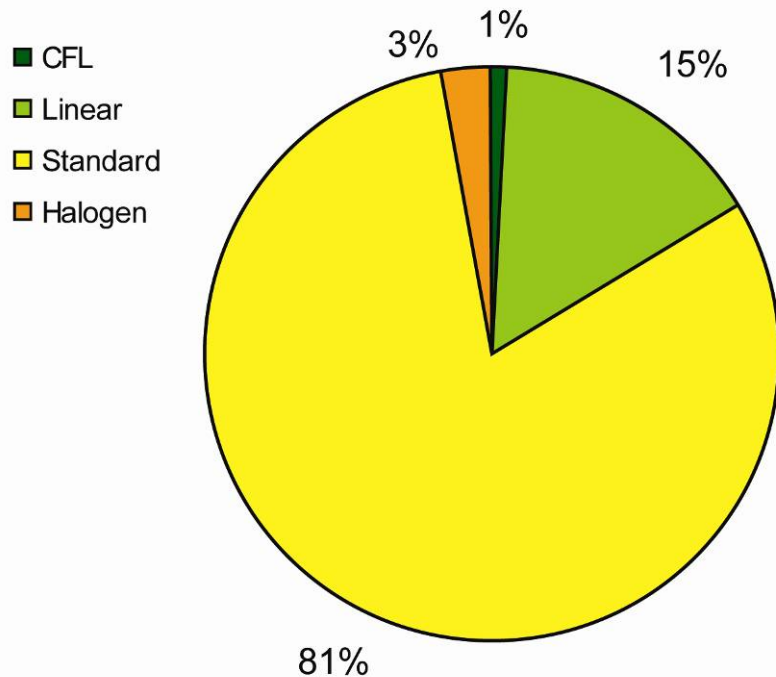
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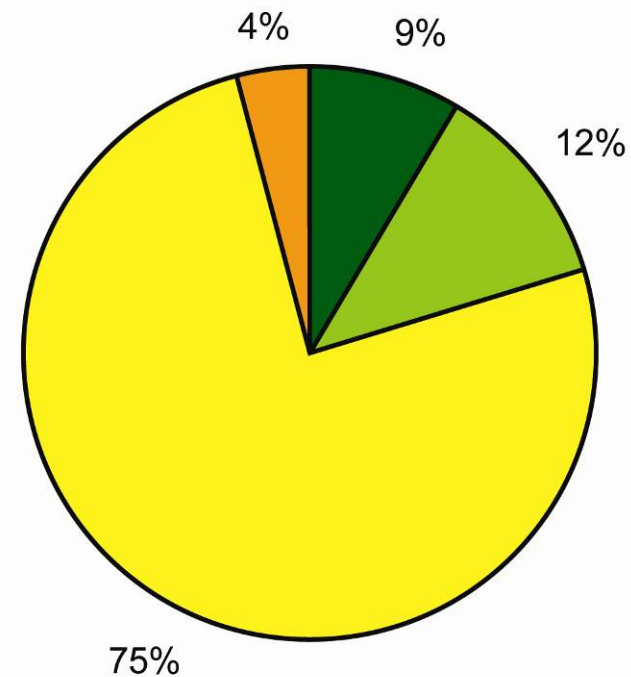
Residential Lamp Stock Breakdown

Estimate of California Residential Market

California Installed Residential Lamp Stock - 2000



California Installed Residential Lamp Stock - 2005



* Calibrated using RLW Analytics CLASS Study

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Residential Lamp Stock Breakdown

Estimate of California Residential Market

- 2007 - Estimates of as much as 15% CFL



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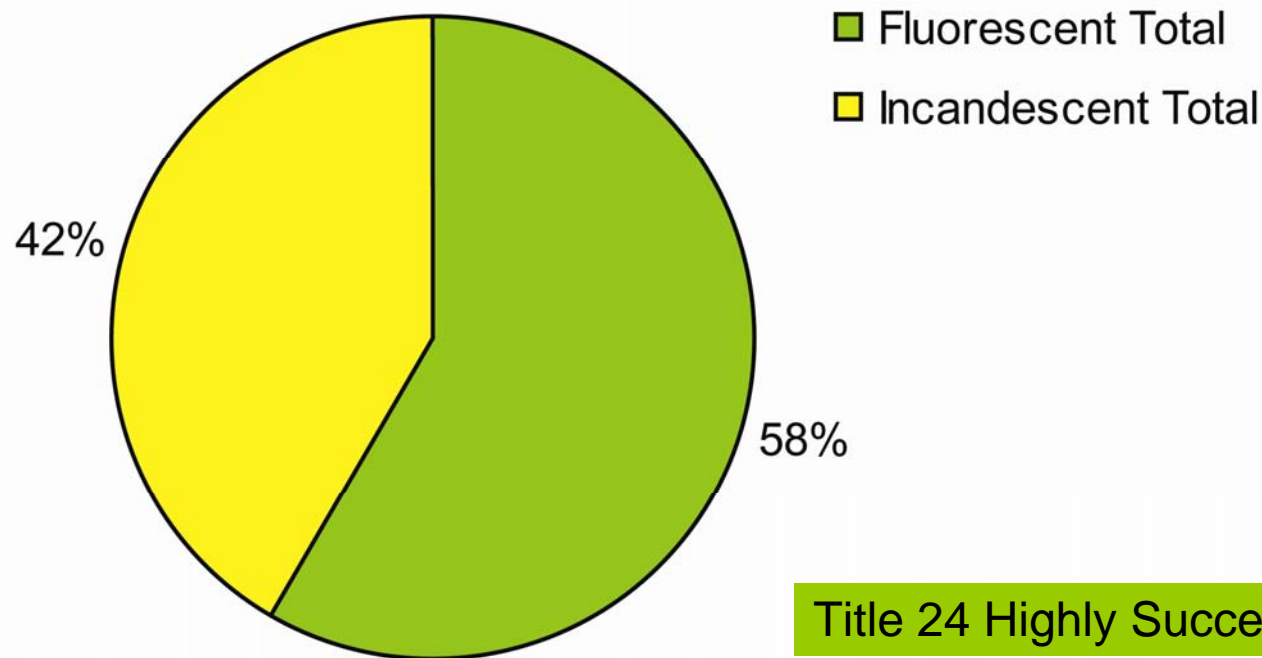
Residential Lighting Survey

- Survey of builders
- Review of
 - Market studies
 - Building plans



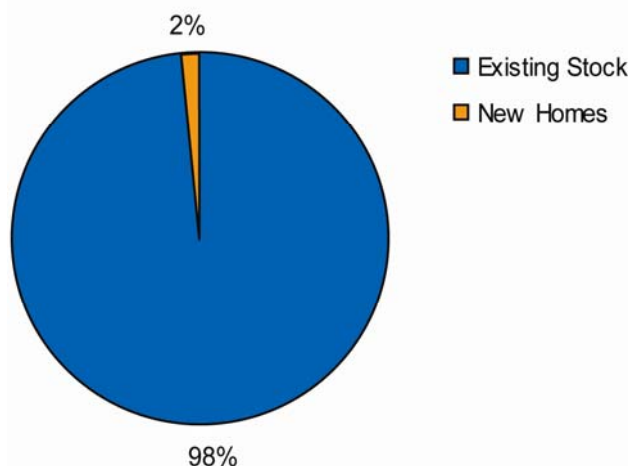
Residential Lighting Survey

CLTC survey of new 2007 homes
(2-6 bedrooms / 2000-4500 sq ft)

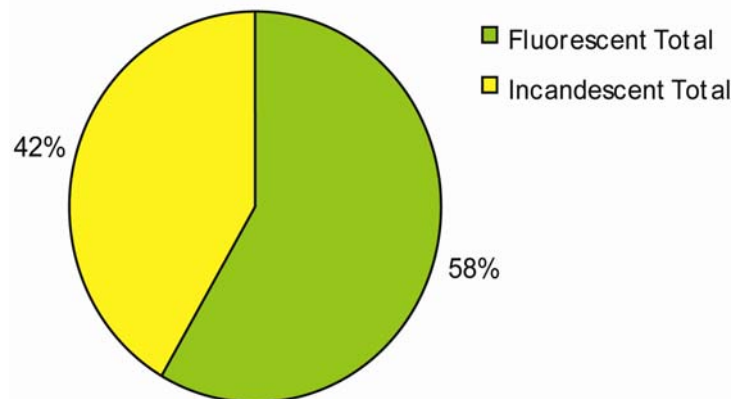


Residential Lighting Survey - Analysis

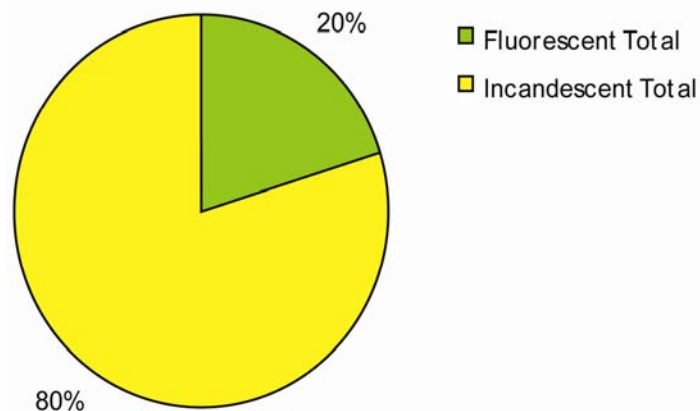
Existing Housing Stock vs New Construction



California New Construction Stock



California Installed Housing Stock



** Calibrated using RLW Analytics CLASS Study*



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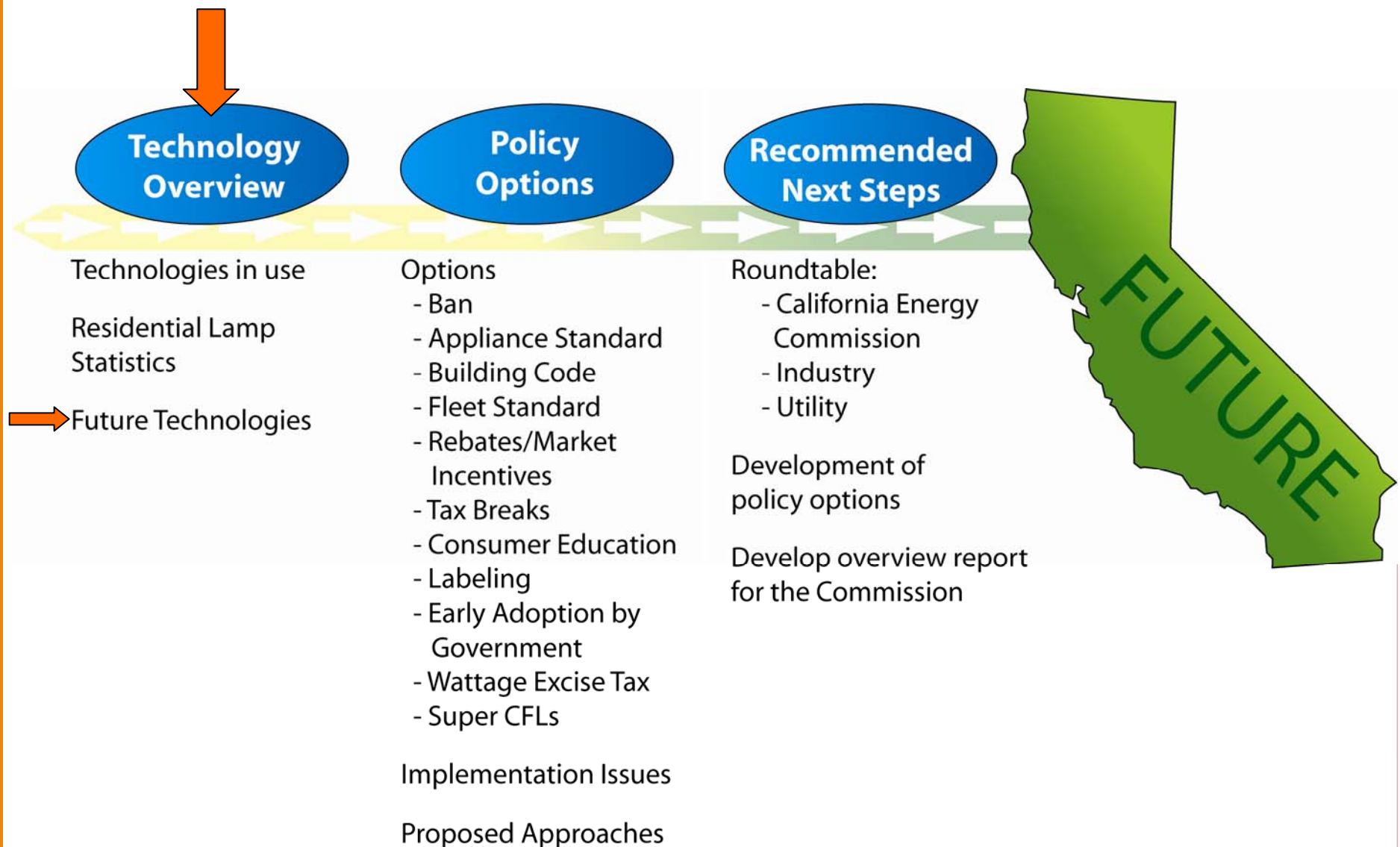
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2007 Title 24 Homes Survey

- ~10 dimmers per home
- >90% of incandescent hardwired fixtures on dimmers





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Opportunities for California

- Enhanced Incandescent
- Halogen
- CFL
- LED



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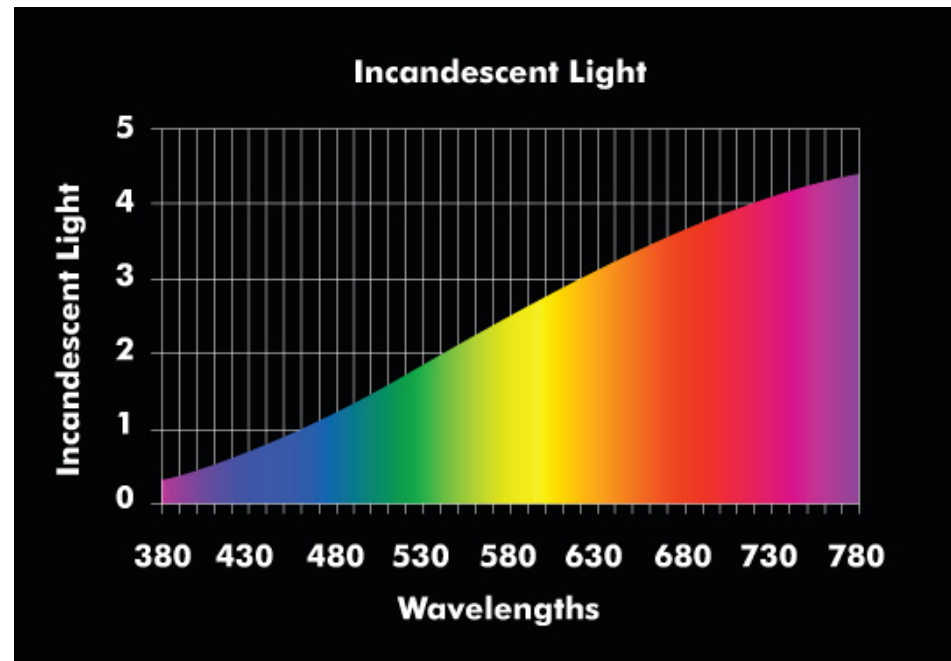
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Incandescent

Basic principle:

- *Heat a solid material until it glows*



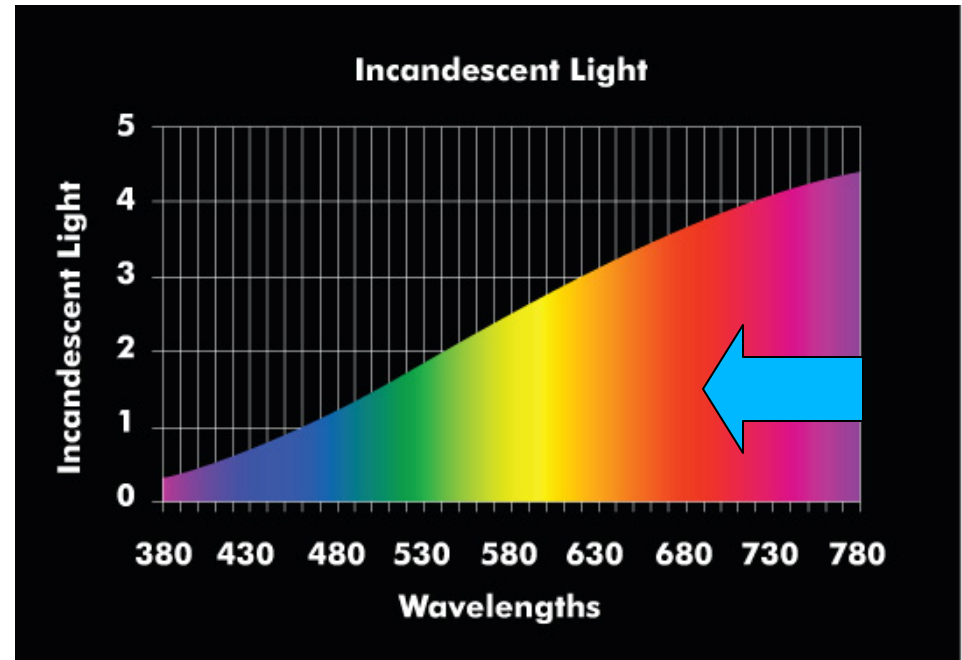
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Incandescent: Efficiency Improvements

1. Halogen
2. Halogen Infrared
3. Enhanced filament



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Halogen: Today's Potential



- Standard A-lamp (10-17 lm/W)
- Tungsten halogen (18-20 lm/W)
- Tungsten halogen HIR (25-27 lm/W)

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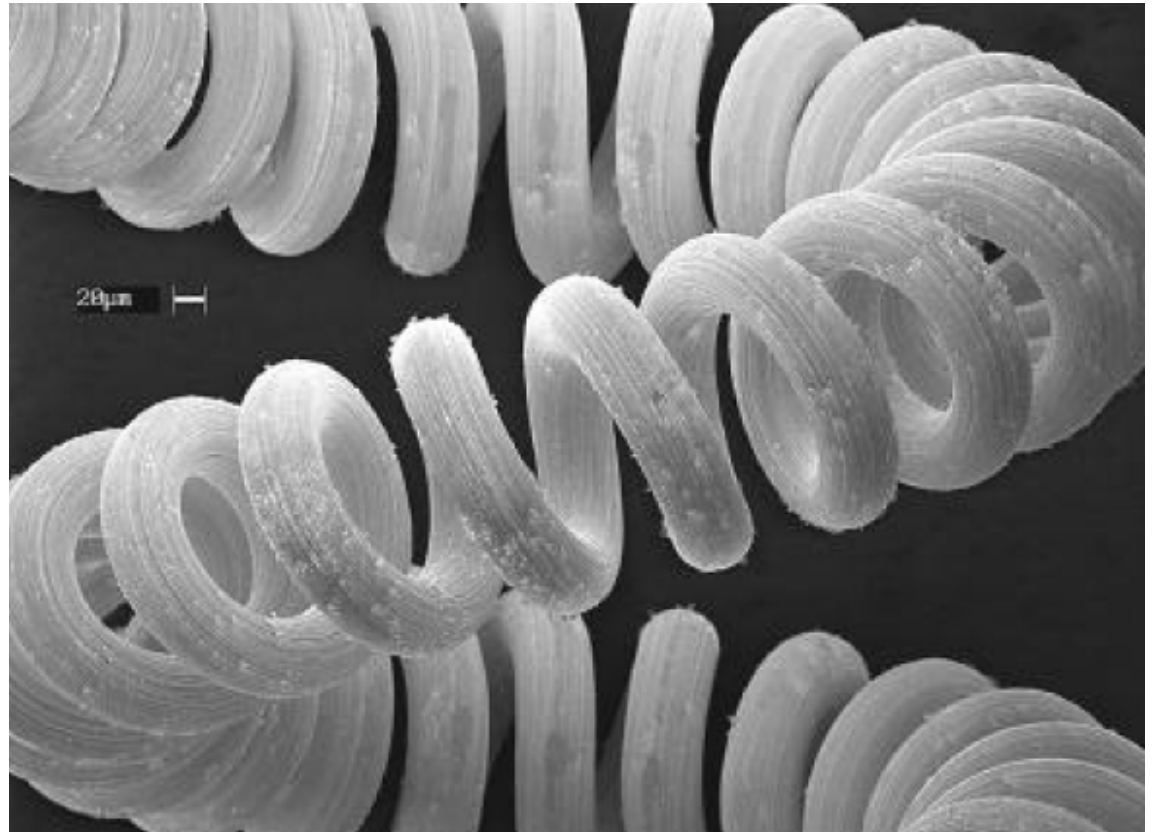
Halogen: Near Term Technical Potential



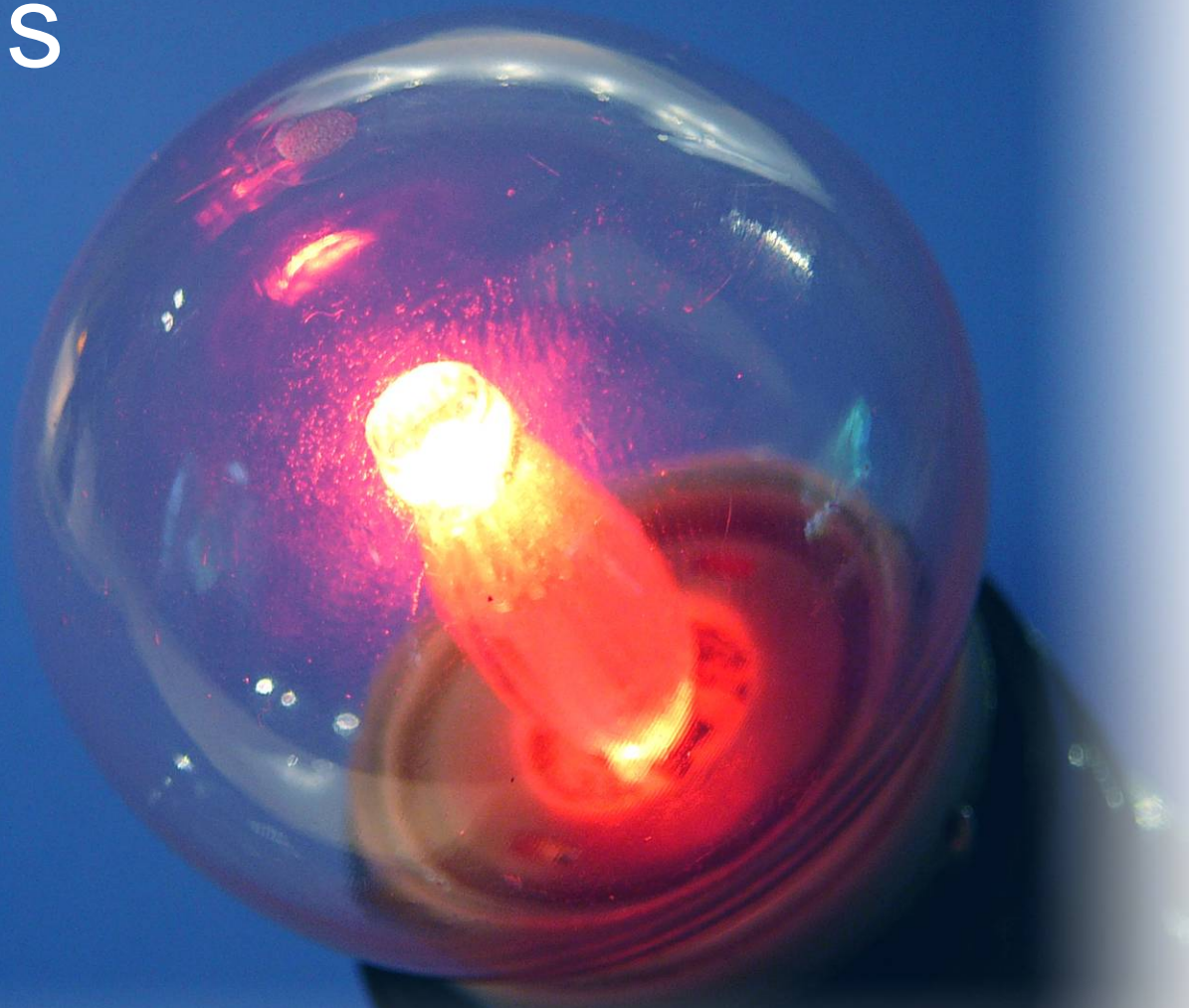
- Super tungsten HIR (27-30 lm/W)
 - Advanced materials
 - More layers
 - Internal optics
- Super tungsten HIR/life (30-40 lm/W)

Enhanced Filaments 20-40 lm/W Potential

- Ceramic tubes
- Rotating filaments
- Tungsten lattices
- Textured filaments
- Selective emitters
- Coating filament to enhance emissivity



LEDs



Today: 40-60 lm/W

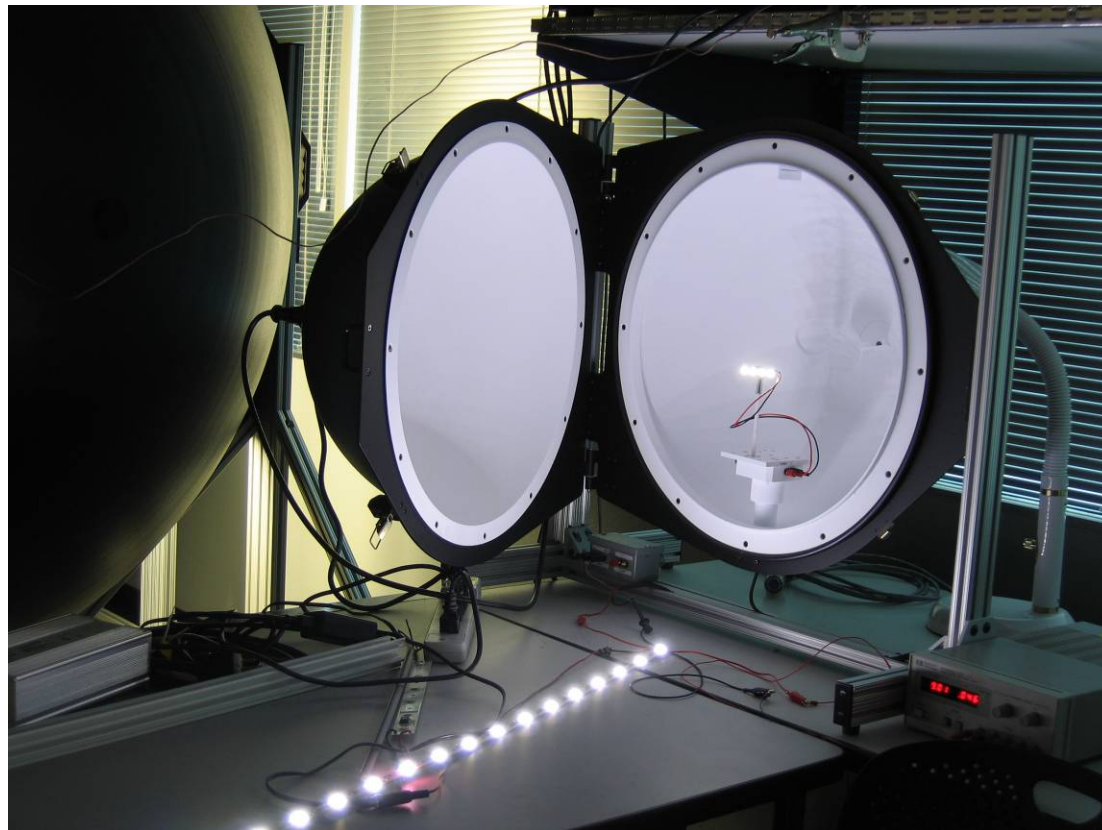
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LEDs

- Tomorrow: 100 lm/W

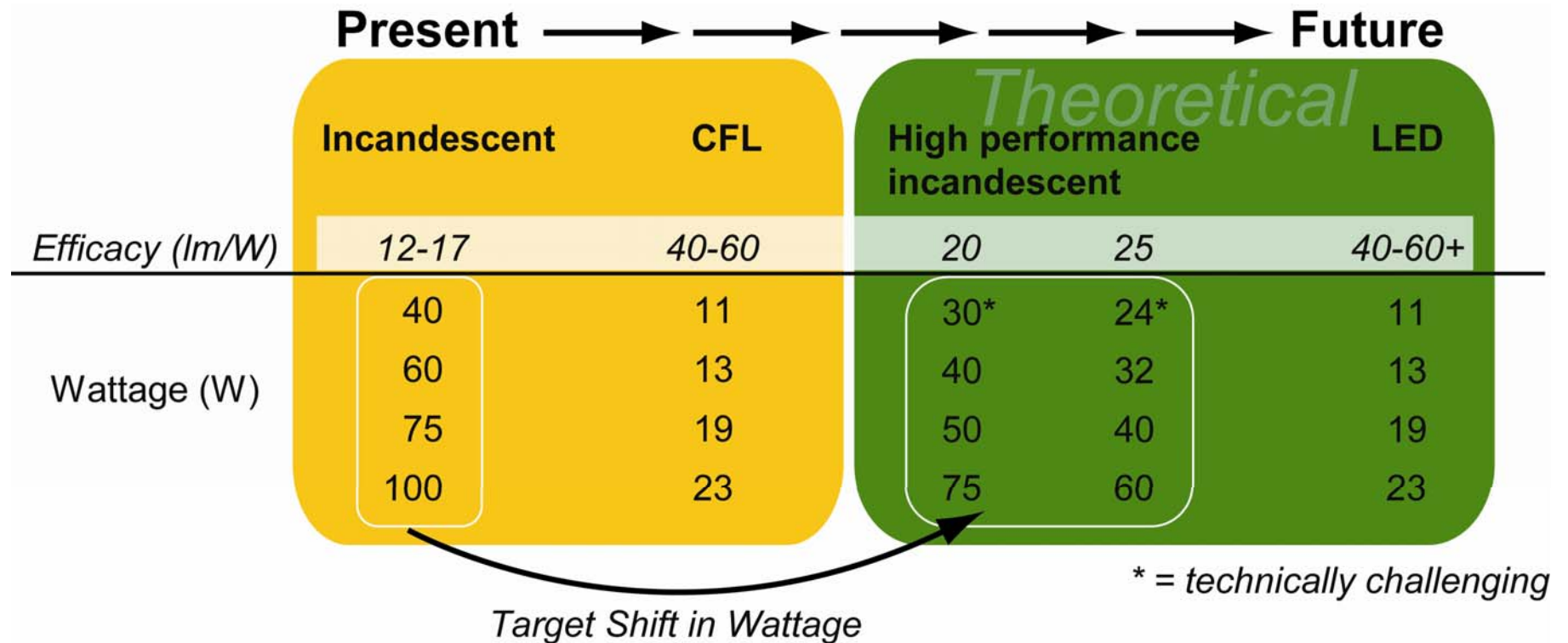


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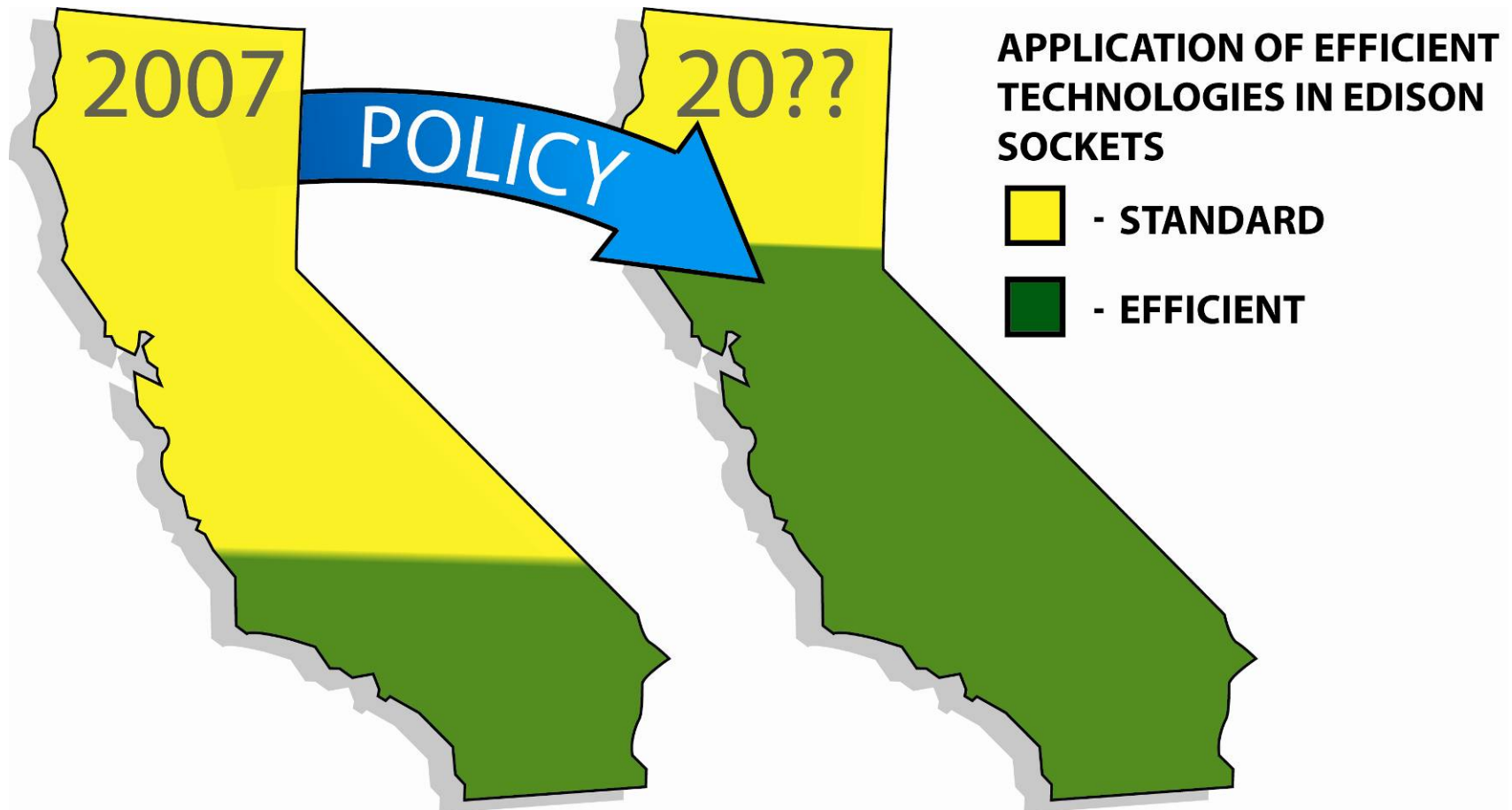
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Wattage Potential



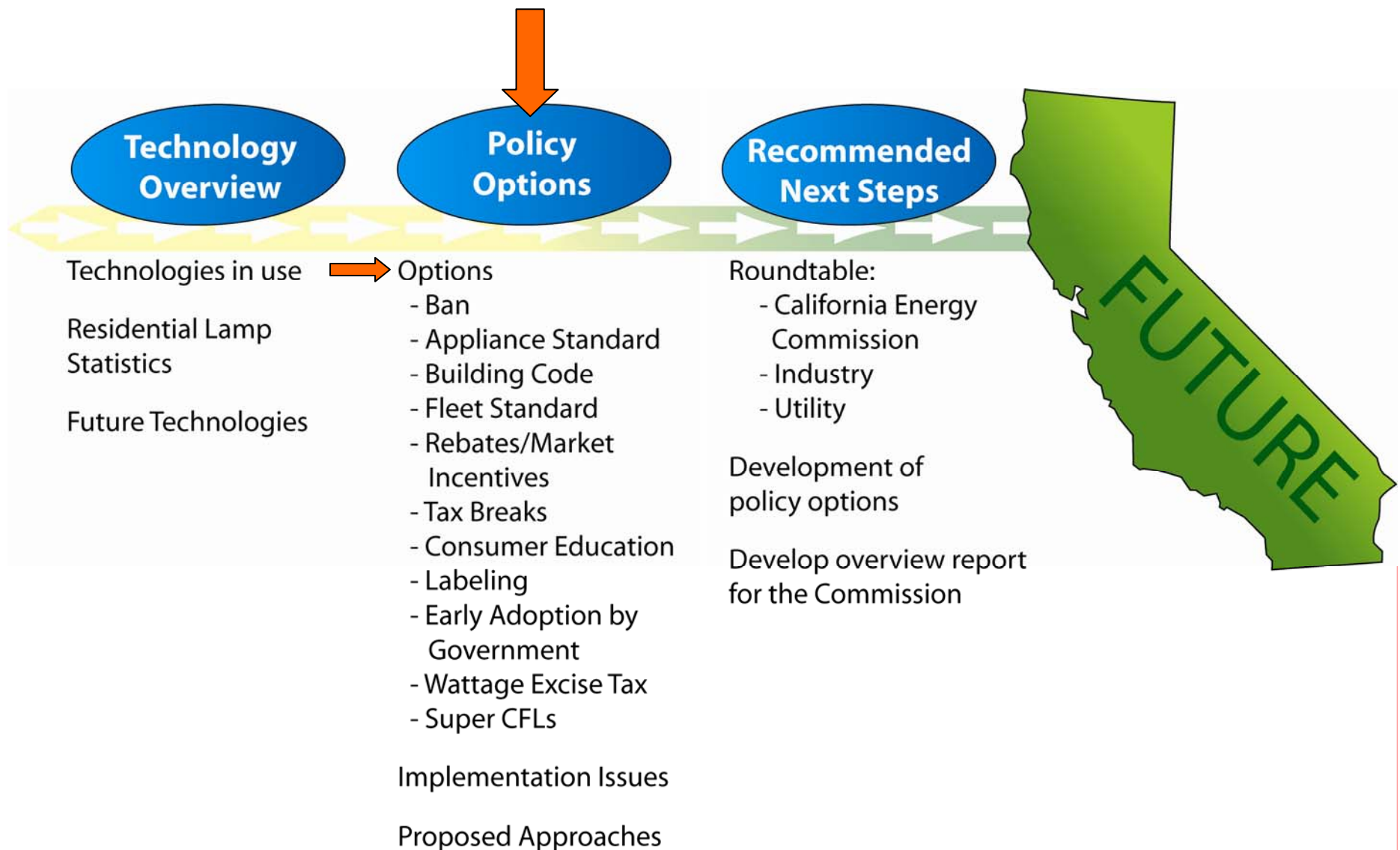
Range of Policy Options



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Policy Options

- Ban
- Appliance Standard (Title 20)
- Building Code (Title 24)
- Fleet Standard
- Rebates/Market Incentives
- Tax Breaks
- Consumer Education
- Labeling
- Early Adoption by Government
- Wattage Excise Tax
- Super CFLs

Initial Response – “Ban”



- Benefits
 - Fast
 - Straightforward
 - Achieves goals

California Lamp Smugglers *circa 2007*



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Ban

- Other unintended consequences
 - **Backwards compatibility** of legal technologies, e.g. standard CFLs and dimmers in 2005 Title-24 homes
 - **Negative response** from consumers
 - **Misapplication** (R-lamps) leading to lower efficiency
 - **Loss of ability to regulate** technologies that are now illegal

Ban – Unintended Consequence

- Compatibility conflicts with Title 24
 - 98% of incandescent sockets on dimmers



Appliance Standards (Title 20)



Technology-neutral,
efficacy-based approach
(lumens per watt)

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Appliance Standards (Title 20)

- Benefits
 - **Technology-neutral**: addresses efficiency directly, without singling out specific products
 - **Well-established** process
 - **Manufacturer autonomy** to meet standards

Appliance Standards (Title 20)

- Unintended consequences
 - **Integration with federal** standards and other jurisdictions
 - Technology mix may **confuse consumer**
 - Migration from **CFLs to new, “efficient” incandescents**

Building Code (Title 24)



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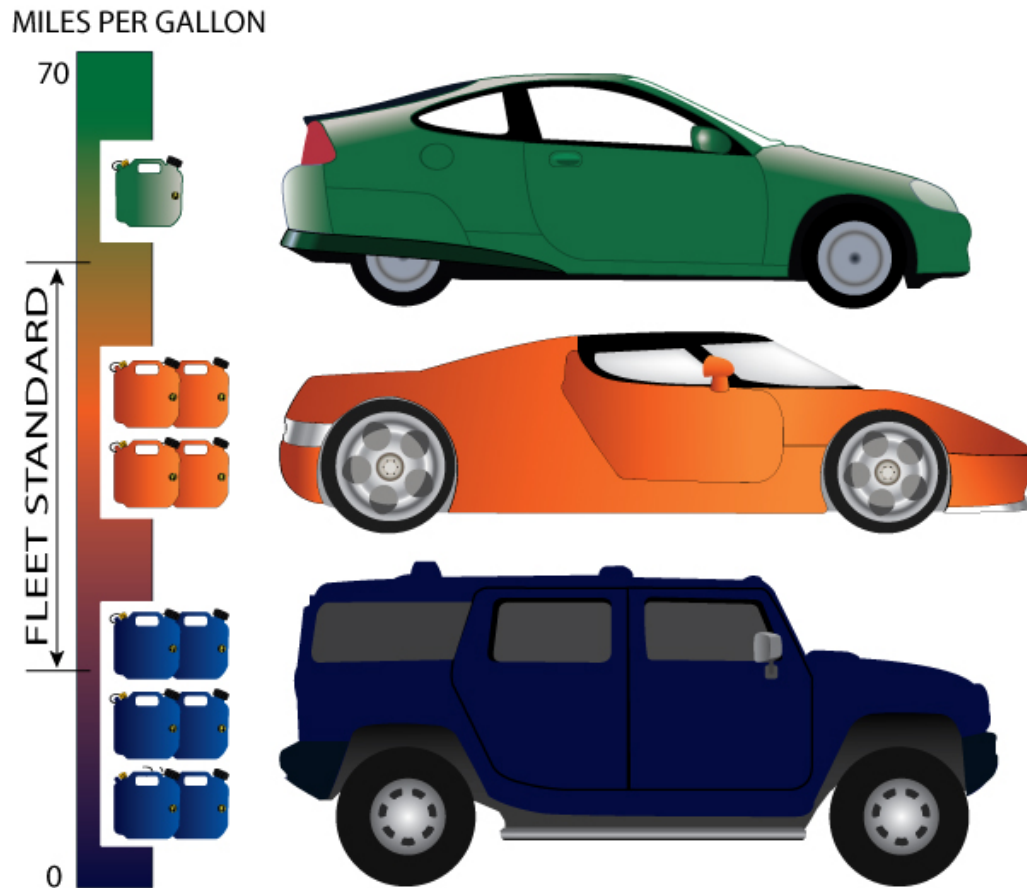
Building Code (Title 24)

- Benefits
 - Highly effective in the **long term**
 - **2007: 58% high-efficacy fixtures**
 - Incorporates **efficiency into the building design** process
 - e.g. Title 24 mandates occupancy sensors and/or dimmers and/or high-efficacy lights

Building Code (Title 24)

- Unintended consequences
 - **Slow**: depends on rate of building construction and renovation
 - **Does not target largest opportunity**: not retroactive to **existing buildings** (except retrofits)
 - **200,000 new households every year vs. 12+ million existing households**
 - **Enforcement** issues

Fleet Standard



Annual average efficacy for all lamps sold by manufacturer or retailer

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Fleet Standard

- Benefits
 - **Technology-neutral**
 - **Manufacturer autonomy** for meeting standard

Fleet Standard

- Unintended consequences
 - A-lamp in the room, CFL in the closet
 - Hard to establish



Rebates and Marketplace Incentives



Government, utility rebates to manufacturer, retailer, or consumer

Benefits

- **No** incentive for **underground market**
- Marketing **flexibility**: **manufacturers may pass** rebate **down** to retailers, consumer
- If rebate **technology-neutral**: **manufacturer autonomy** to develop qualifying technologies
 - $> 20 \text{ lm/W} = \text{rebate?}$

Rebates

- Unintended consequences
 - Potentially **drive consumers away** from **CFL**
 - Needs to be **carefully crafted: depreciates perceived value** of technology
 - Continued **availability of less efficient lamps** at a low price

Tax Credits



Tax credits for consumers

Benefits

- Offsets costs

Unintended consequences

- **Cost to state** for providing incentives
- **Fraudulent claims**
- **Enforcement cost**

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Consumer Education Campaign

Programs that address the barriers to consumer purchase and use of efficient lighting products

Benefits

- Informed **consumers make** more **energy-conscious choices**
- **Promotes lifestyle change** for efficiency
- **Shows consumer how to cut costs**

Unintended consequences

- Continued **availability** of **inefficient lamps** at a very low price
- **Consumer inertia**

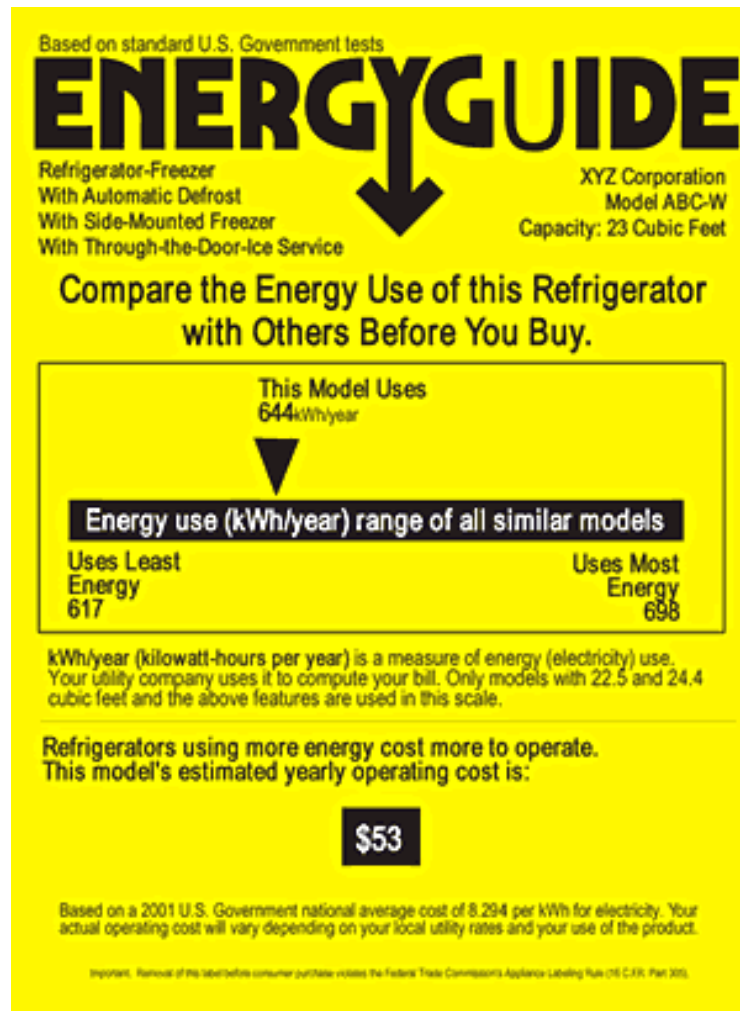


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Product Labeling



- Requirements for clear labelling of e.g.:
 - efficacy
 - total light output
 - quality certifications
 - carbon footprint
 - running cost per year

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Product Labeling

- Benefits
 - **Information and awareness** increases
 - **Increases accountability** of **manufacturer** to produce efficient products
 - Could **tie-in to other** state **initiatives**: e.g. Low Carbon Fuel Standard
- Unintended consequences
 - **Consumer inertia**: most effective on the interested and aware consumer
 - May be **best combined with other programs**
 - **Confusing if too detailed**
 - Continued **availability** of **inefficient lamps** at a very low price does not address consumer sensitivity to price

Early Adoption by Government



Benefits

- **Increases public education**
- Government leads by **example**
- Creates **test market**

Unintended consequences

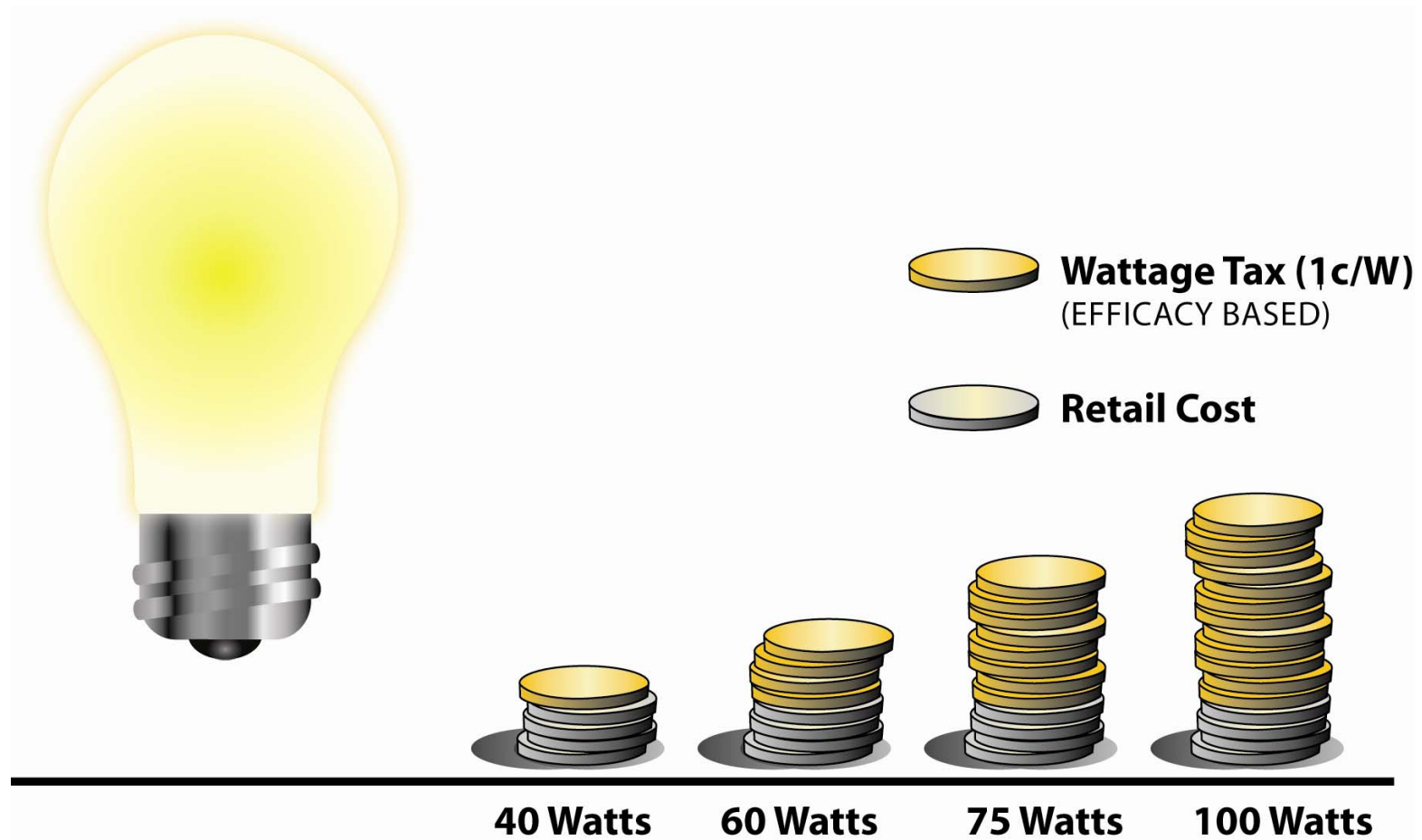
- May **require** major **retrofitting**
- **Slow:** may not lead to wider **market change**

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Wattage Excise Tax



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Wattage Excise Tax

- Benefits
 - **Incentivize efficiency**, taxes inefficiency
 - **Funds efficiency education** programs
 - **Reduces consumer inertia**: consumer must explicitly decide to buy more expensive lamp
- Unintended consequences
 - **Unpopularity** if consumer not aware of motivation

Super CFL Program



- Promote availability of higher performance CFL
 - Color
 - Life
 - Dimmability

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“Once they got to the point where they could **shrink the fluorescent lamps**, make them compact, then **obviously that's the way to go** rather than this.”

Frederick Mosby

Inventor of the Halogen A lamp, 1966

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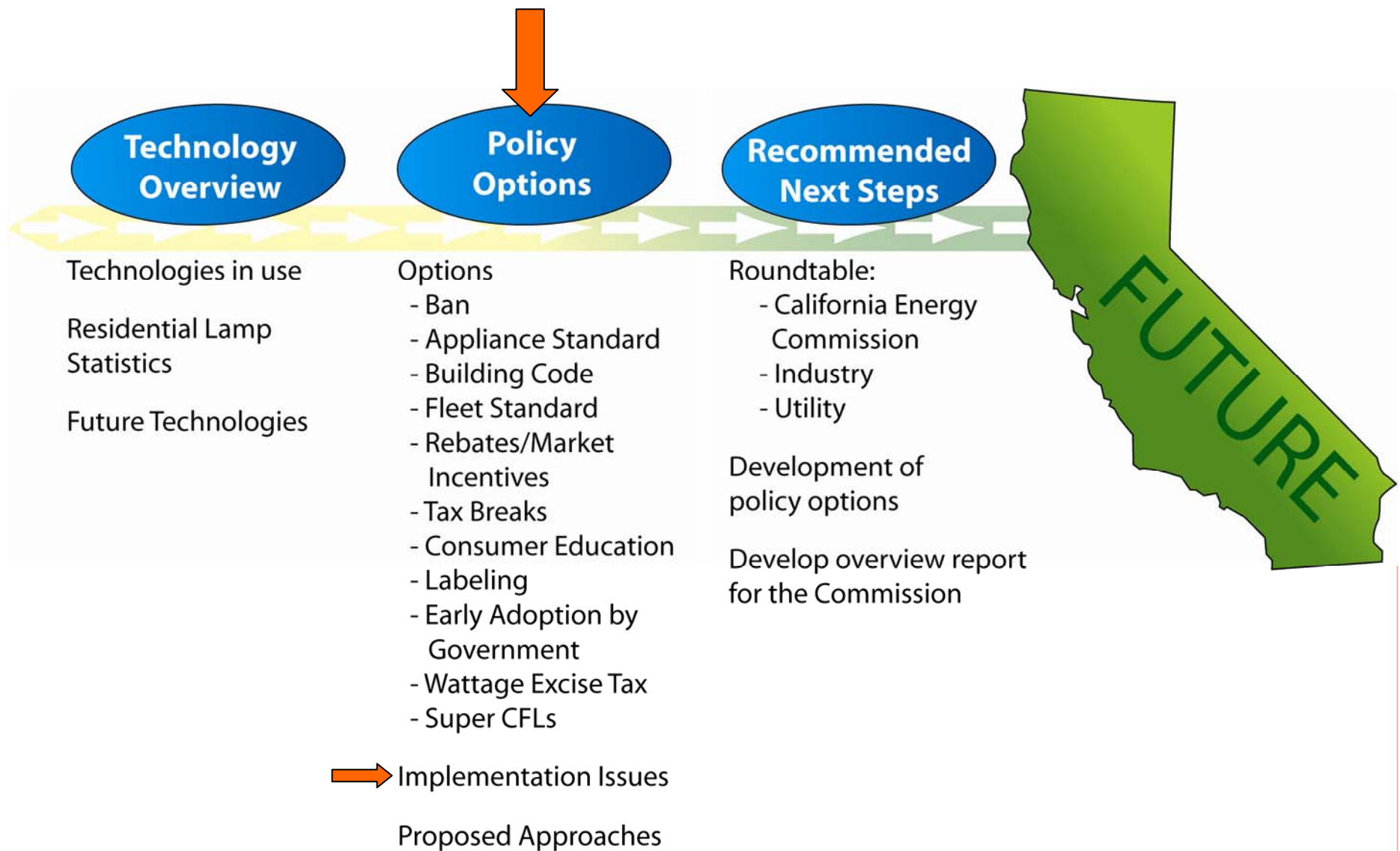
Super CFL Program

- Benefits
 - **Higher savings** potential
 - **CFL becomes preferred light source** through major improvements in
 - Color
 - Life
 - Dimmability



Super CFL Program

- Unintended consequences
 - **Consumer inertia**
 - Historic memories hard to overcome
 - **Requires major investment in**
 - Specification
 - Rebates
 - Education



Policy Implementation Issues

Issues that apply to several of the presented policy elements

- CFL disposal
- Incremental vs. Single-step
- Phasing
- Exemptions
- Misapplication



CFL Disposal



- Increased CFL use creates **more hazardous waste**
- Current **infrastructure** already **insufficient**

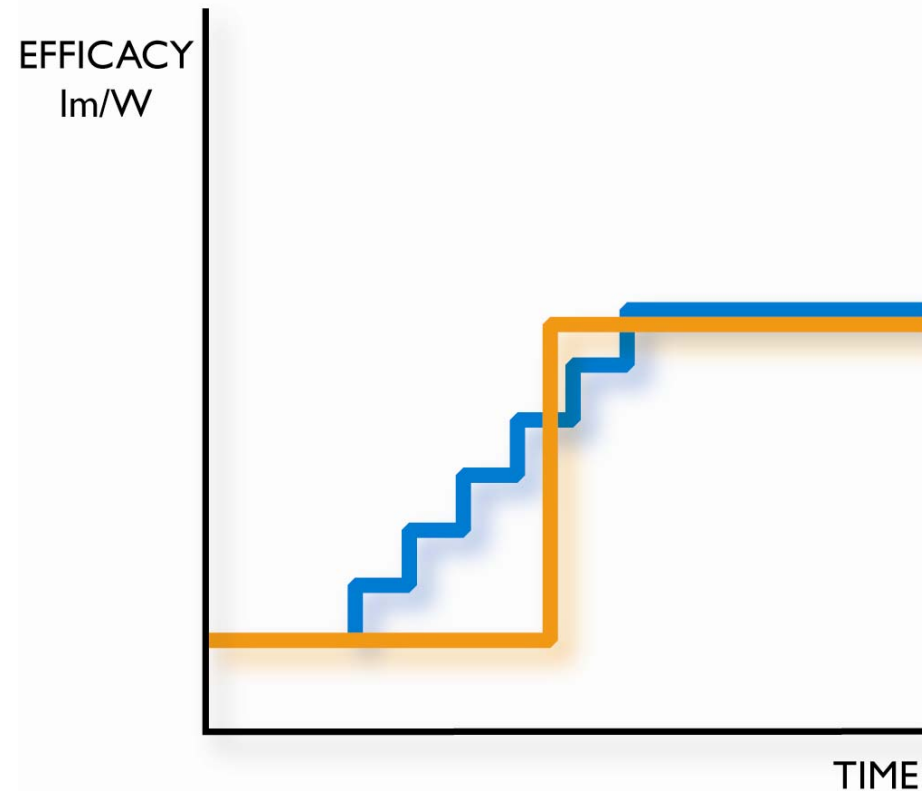
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Incremental vs. Single-Step Efficacy Standard

To be discussed at
roundtable



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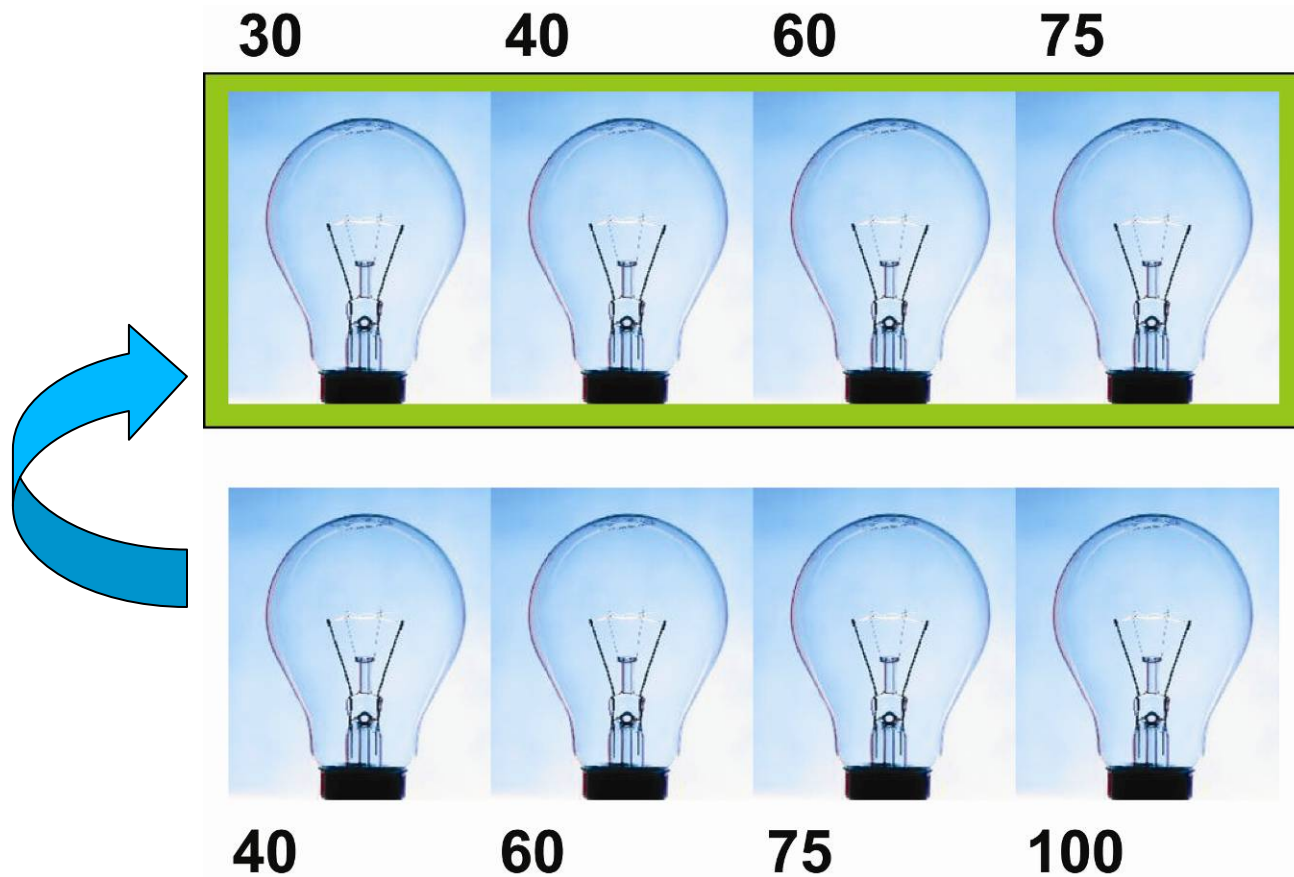


Phasing – Title 20 A lamp Potential Rulemaking

- Targeting single wattage first?
- Why?
 - Allow industry to gear up
 - Provides smooth market entry
 - Allows incentive programs to evolve
 - Allows technology to evolve to planned efficacy

Across the Board – lm/W Standard

- Impractical

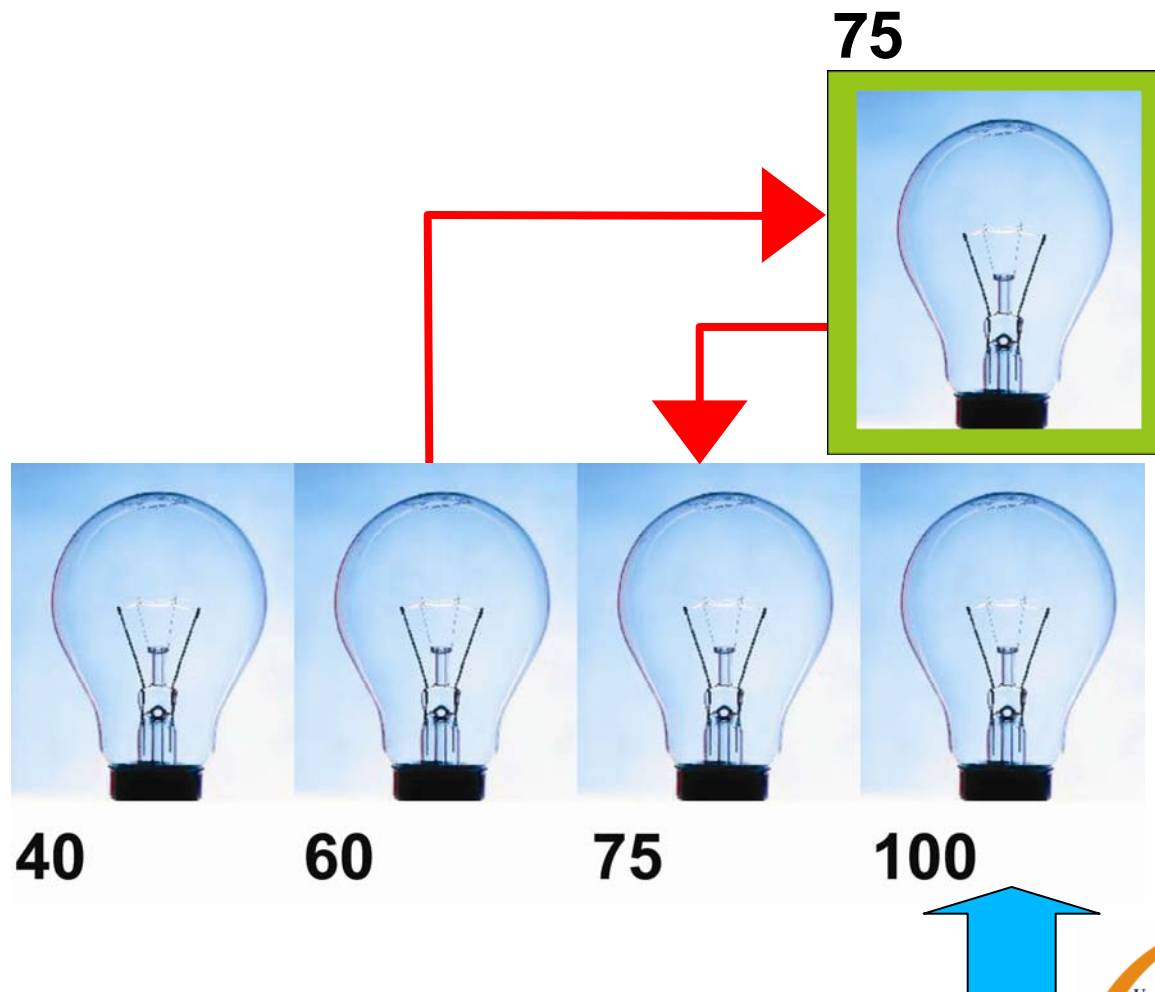


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Target 100 watt Lamps and with Rebates + Education

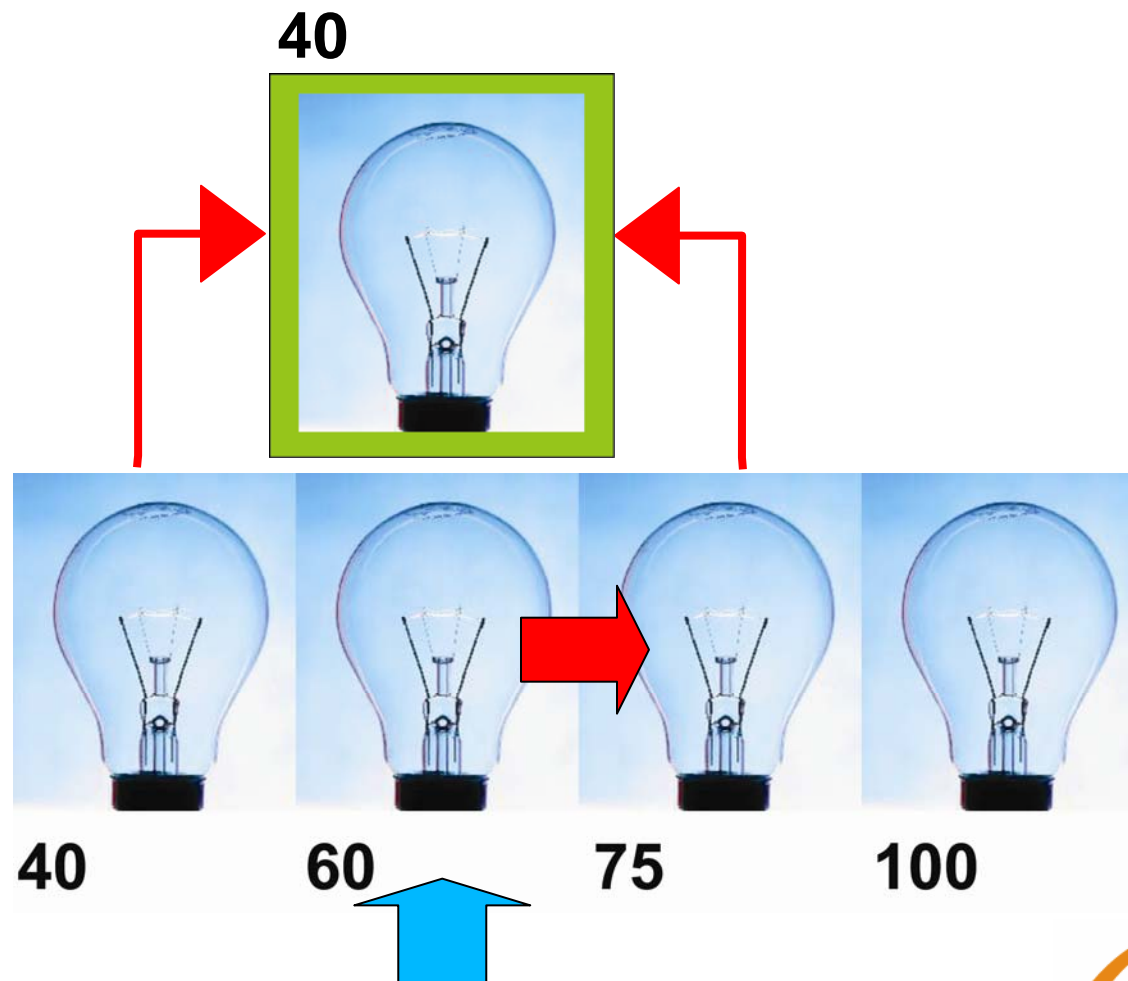


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Target 60 watt Lamps and with Rebates + Education



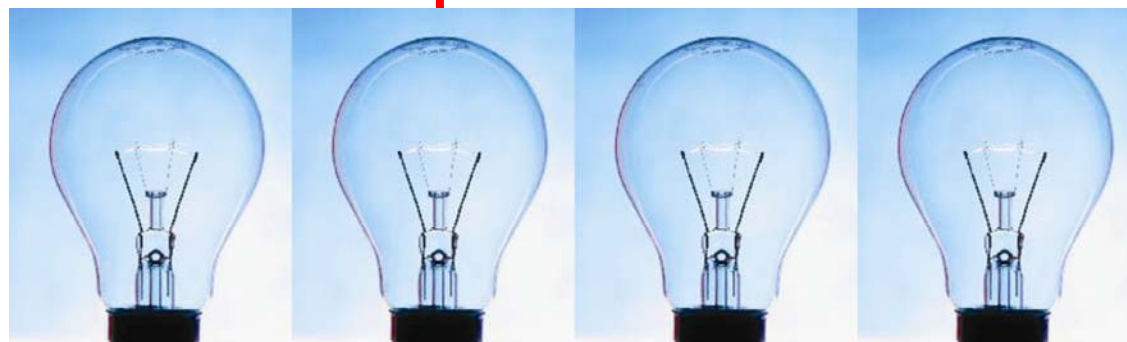
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Target 40 watt Lamps and with Rebates + Education

30



40

60

75

100



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Phasing

- Consequences **hard to predict**
- Possible **unintended consequences**
 - Artificial market shifts
 - Potential increases in energy use
 - Consumer dissatisfaction

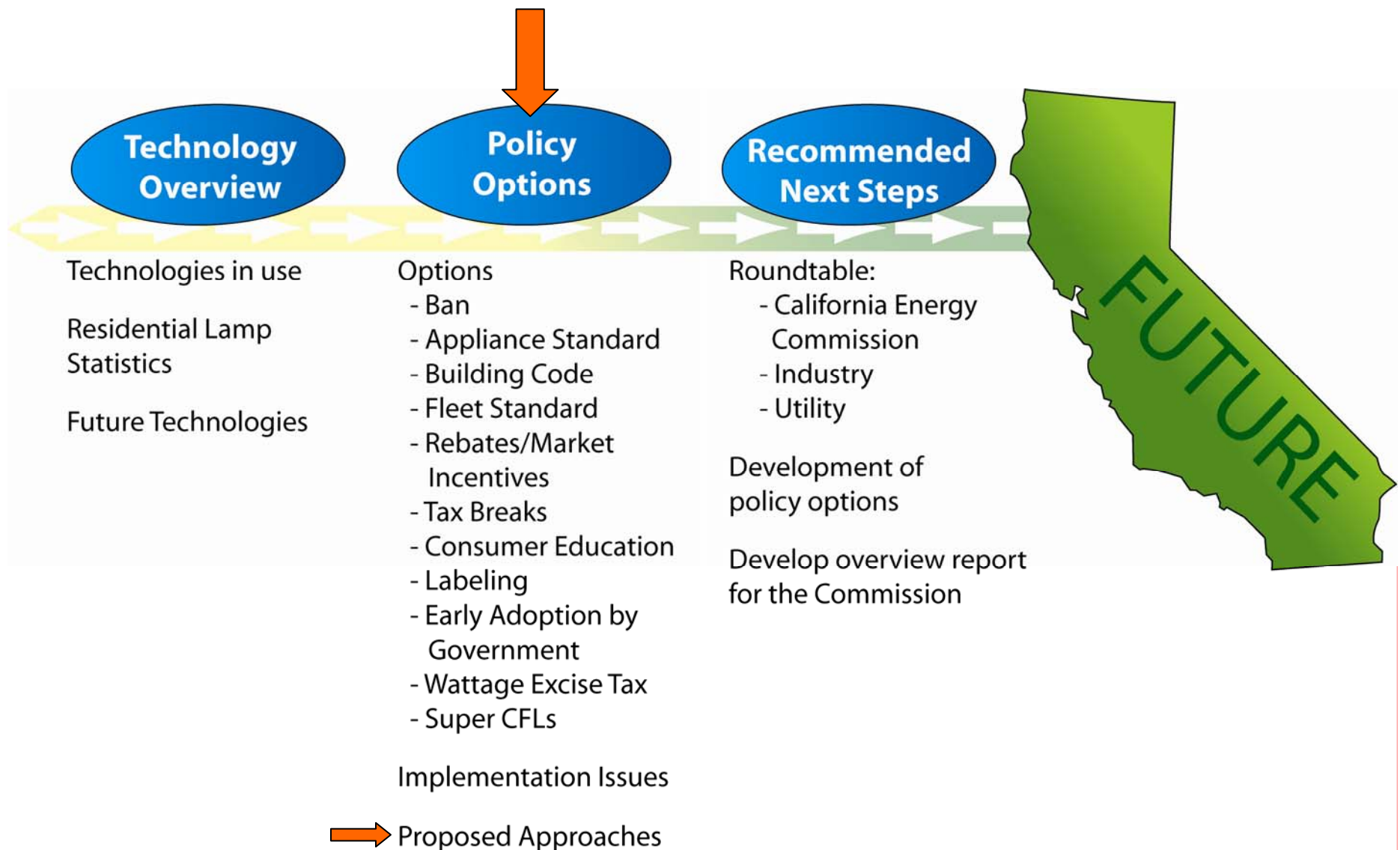
Exemptions

- **Loophole** that could allow inefficient lamps under following designations
 - Enhanced spectrum lamps
 - Infra red lamps
 - Reflector
 - Rough service
 - Shatter resistant
 - Sign service
- **Need safety net** to address market fluctuations
 - Above certain sales volume, lamp should no longer be exempted

Misapplication

- Targeting general service lamps without addressing reflectors could take us from **15 lm/W to 10 lm/W**





Policy Integration – a Better/Best Approach

- 1) CFL development + promotion
 - Super CFL specification
- 2) Regulatory framework
 - Title 20 with smart phasing
- 3) Behavioral change
 - Incentives + education

1) CFL Development + Promotion

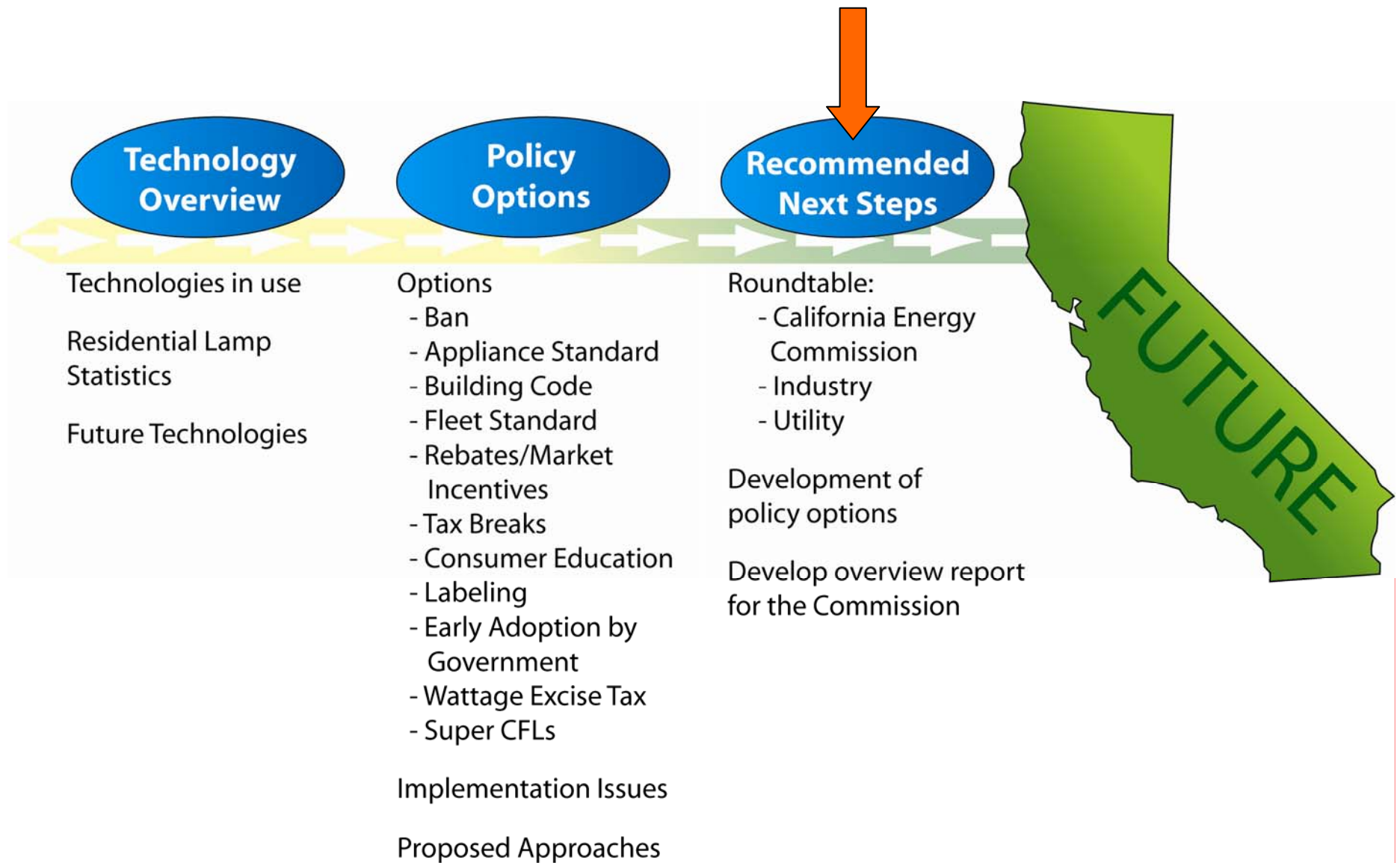
- Higher performance CFL could be very successful with aware public
- Addresses migration from CFL to “efficient” incandescents
- Start now to avoid mixed messages

2) Regulatory Framework

- Title 20
 - Efficacy based technology neutral
 - Phasing
- Provides regulatory support to education and incentives
- Higher effectiveness of incentives and education

3) Behavioral Change

- Changes consumer behavior
- Maximizes consumer receptiveness
- Could be carefully compounded with branding and/or labeling policies for maximum effectiveness



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Next Steps

- Stakeholder meetings (better/best approach)
 - Develop Super CFL specification and program
 - “x and the y” (schedule and efficacy - Title 20)
 - Wattage Targets
 - Phasing
 - Exemptions?